Appendix A: Preliminary Assessment of the East-West Routes

The purpose of this preliminary assessment is to provide a foundation and baseline for an in-depth review of east-west rail corridors in Washington State. This baseline is designed to be the first step in a much larger study of passenger rail service. It is anticipated that once legislative funding for a larger study is available, this preliminary assessment will help guide development for the in-depth east-west corridor review.

This preliminary assessment presents a brief discussion of railroad characteristics and operations as well as the current conditions on the three existing Burlington Northern and Santa Fe Railway Company's (BNSF) main lines. This appendix also provides a general assessment of each route's ability to handle additional passenger rail service.

The review and assessment of a rail corridor requires an understanding of the current physical and operational characteristics of the existing rail line. It can then be determined if the rail line can physically handle additional trains at the desired times.

What are the three east-west main line routes?

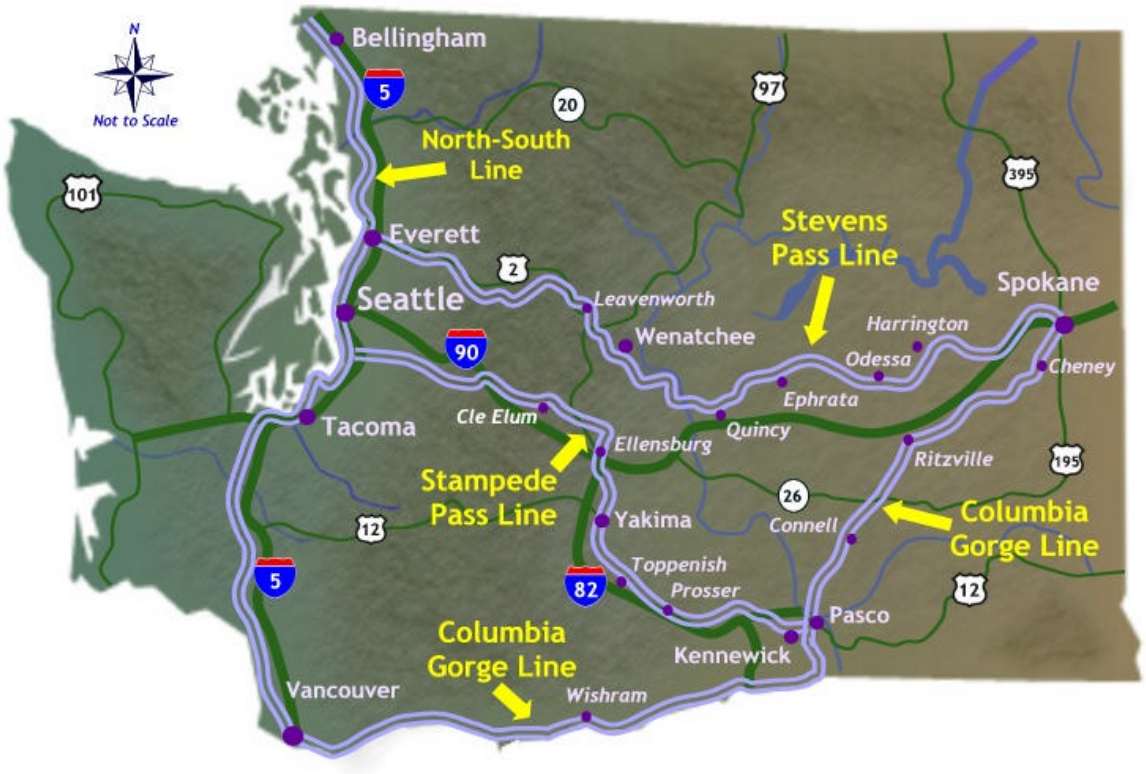
The two active[A.1] east-west rail lines that currently provide passenger rail service are the Stevens Pass route and the Columbia River Gorge route. Both east-west routes travel westerly from Spokane, across the Cascade Mountains, and eventually connect with the BNSF north-south main line in western Washington. This north-south main line carries the current *Amtrak Cascades* passenger rail service, and serves passengers between Eugene, Oregon and Vancouver, British Columbia via Portland and Seattle. Amtrak's *Coast Starlight* also travels along this north-south main line. It is a long-distance train traveling between Los Angeles, California and Seattle, Washington.

In addition to these two routes, BNSF also has an east-west main line over Stampede Pass. **Exhibit A.1 on the following page** provides a general vicinity map of each of the routes.

[A.1]Two abandoned east-west rail corridors also exist, but are not included as part of this preliminary feasibility study. One rail line is located between Pasco and Spokane, and was formerly owned and operated by Burlington Northern Railroad. This route is the old SP&S route that travels via East Pasco, Kahlotus, Washtucna, Hooper, Lamont, and South Cheney.

An additional abandoned rail corridor, also known as the John Wayne Trail, (formerly owned and operated by the Chicago Milwaukee St. Paul and Pacific Railroad), extends between the Seattle area and the Idaho border near Tekoa, in Whitman County. A significant common feature of the two abandoned lines is that they generally extend through sparsely populated areas, and therefore are not conducive to passenger train service. However, further study may show significant usefulness of the Ellensburg – Lind portion of the Chicago, Milwaukee, St. Paul and Pacific Railroad right-of-way for direct passenger train service between Seattle and Spokane.

Exhibit A.1
East-West Rail Corridors



Where is the Stevens Pass route located?

The Stevens Pass main line leaves Spokane and travels west, across the Columbia River into Wenatchee. From this point, the rail line extends over the Cascade Range via the historic 8-mile long Cascade Tunnel. The line continues west into Everett where it joins the BNSF north-south main line.

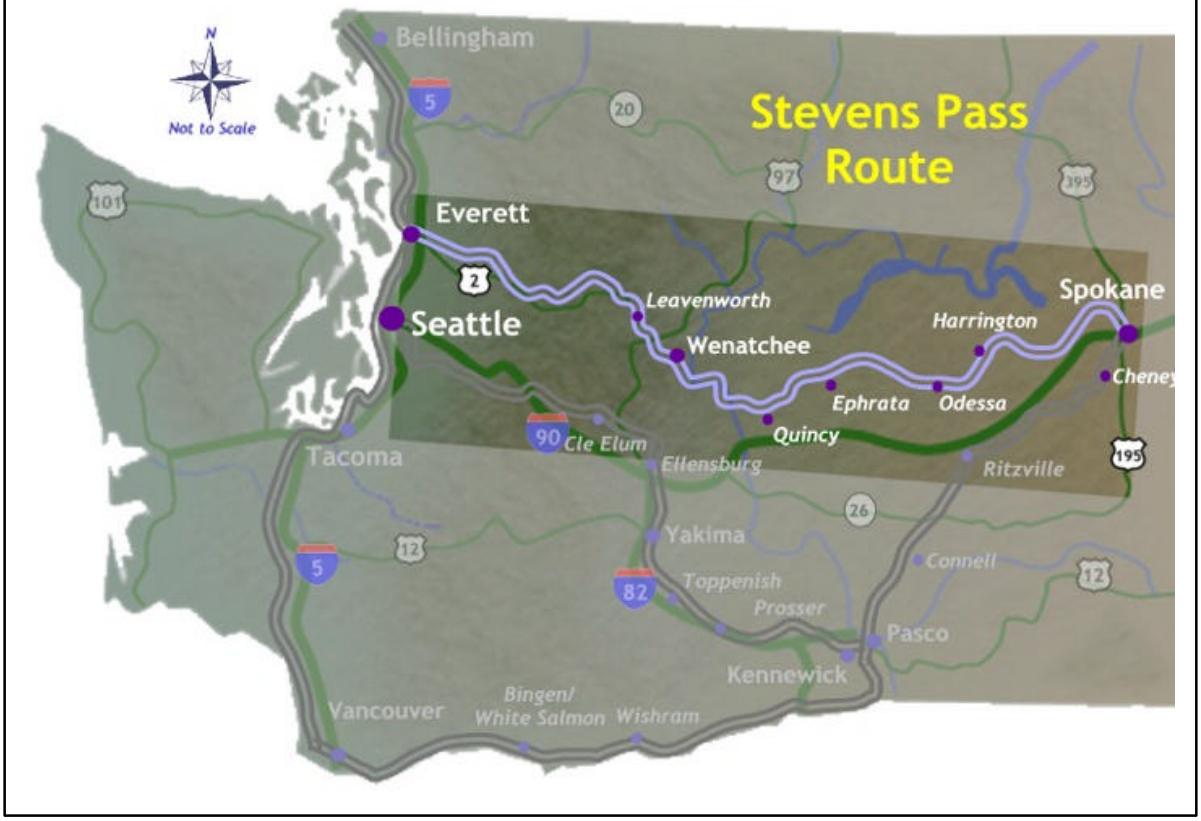
Exhibit A.2 on the following page provides a general vicinity map of the Stevens Pass route.

Where is the Columbia River Gorge route located?

The Columbia River Gorge route has two segments: from Spokane to Pasco[A.2] and from Pasco to Vancouver, Washington (Columbia River Gorge main line). To reach the Columbia River Gorge main line from Spokane, the route follows the former Northern Pacific (NP) main line out of Spokane through Cheney, Ritzville, and Connell to Pasco. The old NP main line then connects with the Columbia River Gorge main line in Pasco, following

[A.2]Throughout this report, this line segment is also referred to as the Pasco East main line or route.

Exhibit A.2
Stevens Pass Route



the north bank of the Columbia River from Pasco into Vancouver, Washington. At Vancouver, this route also connects with the BNSF north-south main line, where it extends north towards Seattle and south into Portland, Oregon. **Exhibit A.3** on the following page provides a general vicinity map of the Columbia River Gorge route.

Where is the Stampede Pass route located?

To reach the Stampede Pass line from Spokane, it is necessary to follow the Pasco East main line to Pasco (this is the same line used to access the Columbia River Gorge main line from Spokane).

The Pasco East main line connects with the Stampede Pass main line in Pasco, continuing northwestward up the Yakima Valley (**see Exhibit A.4**). A number of communities are located along this route, including Kennewick, Prosser, Toppenish**,** Yakima, Ellensburg, and Cle Elum.

From Ellensburg the line continues towards the Cascade Mountains where it rises to 2,840 feet and crosses the mountains at Stampede Pass via the 1.8-mile long Stampede Tunnel. The rail line continues west into Auburn where it joins the BNSF north-south main line. From here the main line continues north towards Seattle and south towards Tacoma (and Portland, Oregon). The Stampede Pass main line is currently used by BNSF freight trains.

Exhibit A.3

Exhibit A.4
Stampede Pass Route

Exhibit A.5
Types of Railroad Capacity

THEORETICAL CAPACITY	The number of trains per day that could run over a route in a strictly perfect, mathematically generated environment. This number is useful because it is relatively easy to generate. For example, if the longest running time between two sidings is one hour, that implies that it would take at least two hours between trains to travel in each direction. This would imply a capacity of 12 trains traveling east and 12 trains traveling west, each day (or 24 trains per day).
PRACTICAL CAPACITY	It's not possible to actually run the number of trains you work out mathematically. Things will happen—one train doesn't have enough locomotive power, the rail is slippery, there is wind or fog, or the engineer is a little slow on his train handling. A reasonable and regularly used figure for what the real world might produce is 75 percent of the theoretical capacity. Using this relationship for practical capacity makes it possible to produce a reasonable estimate fairly easily.
COMMERCIAL CAPACITY	Commercial capacity is simply the practical capacity available during the times when business needs would actually want shipments to move. Practical capacity is the number of trains you could reasonably expect to run in a day, but using all of it would require you to run trains when you don't need them. Suppose that the Seattle area could practically accept one train an hour and send out one train per hour. However, shippers want to receive their shipments before 6 a.m. so they can be ready for the day's business, and they want to send shipments after a day of loading cars (say, after 6 p.m.). In effect, the commercial capacity in this very simple example is six trains per day outbound from 6 p.m. to midnight and six trains per day inbound from midnight to 6 a.m. Shippers might want to increase their rail business to a level that would need ten trains, but since their businesses only accept or send out shipments at certain times, the commercial capacity is much less than the practical capacity.

How were these routes compared?

A review of general railroad characteristics along each of these routes compared current operations and physical conditions.

What are general railroad characteristics?

While there are fundamental distinctions between the operations of a railroad and a highway network, some of the basic characteristics are similar. Certain design standards (that dictate physical characteristics) are applied to rail construction, just as there are standards applied to highway construction. In both cases, the design standards are derived directly from the characteristics of the vehicles and the intended operation of the facility.

How do these characteristics affect the ability to add more trains?

In order to add more trains to a rail line, the tracks need to have the necessary capacity to handle the additional traffic. Capacity is simply the number of trains per day that a given rail line can safely

move while meeting a particular schedule.[A.3]

The rail characteristics presented in **Exhibit A.6 on the following pages** explain how each element contributes to the operation of the rail line, thus contributing to its capacity. Therefore, a review of current conditions along each route will provide enough information for a general feasibility assessment for new passenger service.

How was data collected for this preliminary assessment?

In order to carry out this preliminary assessment, the study team performed the following steps:

- Reviewed existing reports and documents pertaining to freight and passenger rail in Washington State;
- Reviewed maps and rail plans, including highway maps, railroad track charts, and topographic maps;
- Collected train information (average number of trains per day on the three routes) from BNSF; and
- Performed a general analysis of rail characteristics of the three routes for capacity.

Specifically, the study team evaluated each route based on:

1. Current rail traffic;
2. Capacity based on existing infrastructure; and
3. Need for new infrastructure.

What assumptions were made as part of this review?

This review of current rail characteristics along the three east-west routes is based on four critical assumptions. These assumptions are:

1. Freight rail traffic will continue to increase in future years on each of the east-west routes;
2. The proposed daylight service will provide one train—during daylight hours—each day, in each direction;
3. The endpoints for the proposed passenger rail service will be Seattle and Spokane; and Vancouver, WA and Spokane; and
4. The proposed new east-west service schedule would be adjusted to integrate with the *Amtrak Cascades* service schedule that runs along the north-south BNSF route.[A.4]

These assumptions were the foundation for comparison of current rail characteristics along the three east-west routes.

[A.3] There are different types of capacity. Three types of capacity referred to in this study are presented in **Exhibit A.5 on the previous page.**

[A.4] This assumption is based on projections of hourly *Amtrak Cascades* service by the year 2018 (between Seattle and Portland). A detailed analysis will be required to review the potential to integrate east-west service into the *Amtrak Cascades* plan. This separate analysis will require detailed ridership studies, cost comparisons, and required infrastructure along the north-south main line.

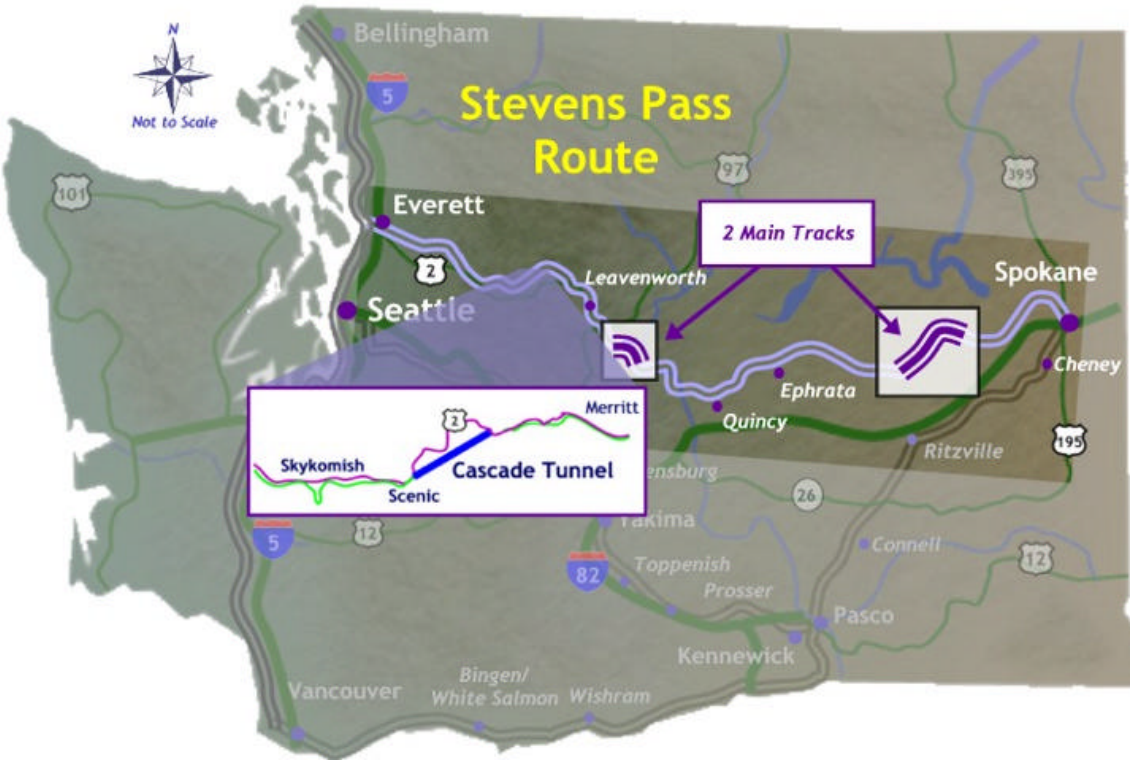
Exhibit A.6
Railroad Characteristics and Their Relevance

CHARACTERISTIC	WHY IS IT IMPORTANT?
Track Structure	Track structure has three elements: rails, ties, and ballast. **Rails** are made of steel. Even though the steel is very hard, the rail wears out, just as highway pavement wears out. The **ties**, typically made of wood or concrete, support the rails. **Ballast** is crushed rock used to support the ties and keep the track in correct alignment while draining off precipitation. The condition of each of these elements dictates the weight and type of equipment that can be used on the line, as well as the speeds allowed on the line.
Number of Tracks	The number of tracks affects the capacity of the line. Two tracks (also called **double track**) have more capacity (the number of trains that can move through the area) than one track (**single track**). **Sidings** also increase the capacity of a single track. A single track line has auxiliary tracks known as sidings. Sidings located along the line allow trains moving in opposite directions to pass each other and allow faster trains to overtake slower trains. The capacity of the rail line and the reliability of operation are affected by the time required to move between sidings.
Grade (the steepness of the tracks at various locations)	The steepness of the track dictates the types of trains that can use the rail line. Typical grades for freight trains do not exceed 2 percent, while grades for passenger trains can be as high as 4 percent. **Ruling grade** is the predominant slope along the rail line. The ruling grade determines how many cars a locomotive can pull over that route.
Curves (often presented in degrees of curvature)	The tightness of the **curve** dictates the speed that a train can travel through it. The higher the degree, the tighter the curve, the slower the speed. Amtrak *Cascades* trains that are used on the north-south main line in western Washington can travel faster through tight curves than standard trains because they use tilt technology.
Speed Limits	Train **speed limits** are derived by considering physics, safety, and regulations. They are generally regulated by the Federal Railroad Administration (FRA). The Code of Federal Regulations (49 CFR 213, Track Safety Standards) establishes classes of track with associated speed limits and detailed physical requirements for tracks in a given class. Speeds may also be restricted by the Washington Utilities and Transportation Commission (WUTC).
Traffic (Number and type of Trains)	The **number and type of trains** that can operate on a rail line relate directly to capacity. The more trains that are put on a track, the more the need for additional track, signals, and improved traffic control.

Exhibit A.6—Continued
Railroad Characteristics and Their Relevance

CHARACTERISTIC	WHY IS IT IMPORTANT?
Signals and Traffic Control: Definition	**Signals** help extend the engineer's sight distance and therefore allow greater speeds. **Traffic control** determines which train can use which tracks to improve safety and ease of movement of trains.
Types of Signals and Traffic Control	
TYPE	**DEFINITION AND USE**
Centralized Traffic Control (CTC)	Traffic control generally consists of an electronic system, usually associated with Automated Block Signals (ABS), or a manual block type system such the Track Warrant Control (TWC) system. Under CTC, the signal system lets a dispatcher at a central location see the location of all trains on a diagram of the tracks. The dispatcher can remotely arrange for one train to safely pass another. The logic built into the CTC system ensures that local wayside signals and track switches are properly set so that locomotive engineers know what the dispatcher intends for them to do in a safe manner.
CHARACTERISTIC	**WHY IS IT IMPORTANT?**
Yard Limit Operation (Yard Limit)	Yard limit operation is a mostly manual traffic control system used in yards and terminals. Trains must generally be prepared to stop within half the range of vision. Because of the great stopping distance of trains, yard limit operation generally requires movement at 20 mph or less.
Occupancy Control System (OCS)	A traffic control system using a combination of Yard Limit operation and verbal instructions from the train dispatcher. OCS is generally limited to terminal areas where trains move at low to moderate speeds.
Restricted Limits	A traffic control system generally allowing trains to use the main track and move as the way is seen to be clear. Similar, except in some details, to yard limit operation.

Exhibit A.7
Stevens Pass Route: Detail Map



What are the current rail characteristics along the Stevens Pass Route?

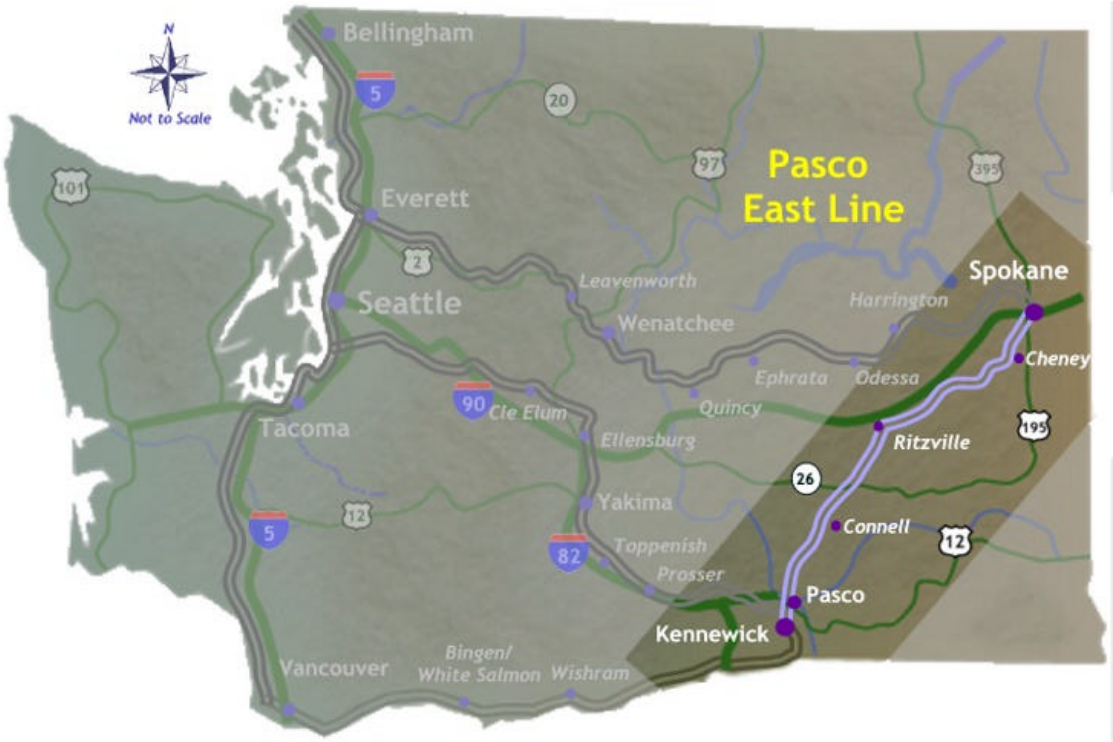
BNSF northern east-west main line is the former Great Northern route over Stevens Pass. A predominant amount of intermodal[A.6] traffic to and from the Ports of Seattle and Tacoma is handled over the Stevens Pass route. The Stevens Pass main line extends from Everett to Spokane via Wenatchee. The distance between Seattle and Spokane via the Stevens Pass route is approximately 330 miles.

The main line is single track for most of the distance and is known for the 7.79-mile Cascade Tunnel that passes below the summit of the Cascades between Scenic and Berne. There is a short stretch of second main track in Wenatchee. About 22 miles of second main track is also located between Lamona and Bluestem in Lincoln County. Centralized Traffic Control is used for almost the entire length of the line. **Exhibit A.7** identifies these locations.

East of Wenatchee, the maximum allowed speed is 79 mph for passenger trains and 60 mph for freight trains. West of Wenatchee, the maximum allowed speed is 79 mph for passenger trains and 50 mph for freight trains. The speed of passenger and freight trains is restricted by curves at numerous locations along the entire route. The average number of trains along this route is 18 trains per day. The highest

[A.6]Freight delivered via truck or ship, and then moved to another destination via rail, is considered intermodal traffic.

Exhibit A.8
Pasco East Route



daily train count is 23. Amtrak's daily *Empire Builder* operates on this route, traveling from Spokane to Seattle. Because of the clearance of the Cascade Tunnel, the Stevens Pass main line provides a cross-state passage for all types of trains.

The ruling grade on this route is 2.2 percent. Significant portions of this main line have a grade of 1.6 percent. There are also long segments of track with grades that range from 0.8 percent to 1.0 percent.

What are the characteristics of the Columbia River Gorge Route?

The southern route extends through the scenic Columbia River Gorge on the former Spokane, Portland & Seattle (SP&S) main line. The Columbia River Gorge main line travels from Vancouver, Washington to Pasco. From Pasco, the route travels north to Spokane along the Pasco East main line. The Columbia River Gorge route is the only water level crossing of the Cascade Range. Much of the grain and other transcontinental traffic to and from the Portland/Vancouver area is transported over this line because of the amount of locomotive energy that would be needed to travel over the Cascade Mountains. The distance between Seattle and Spokane via the Columbia River Gorge route is approximately 530 miles.

The daily average number of trains is 30; the highest daily train count is 37. The Amtrak *Empire Builder* operates on this route daily between Spokane and Portland, Oregon. The remaining traffic is BNSF freight trains.

What are the characteristics of the Columbia River Gorge Main Line?

The entire main line is single track except for a short section east of Vancouver and a short section west of Wishram. Centralized Traffic Control is used for the entire route.

East of Wishram, in Klickitat County, the maximum passenger train speed is 79 mph. West of Wishram the maximum passenger train speed is 70 mph. The maximum freight train speed for the entire route is 60 mph. There are numerous curves along the entire route that restrict passenger train speed and numerous curves west of Wishram that restrict freight train speed.

What are the characteristics of the Pasco East Main Line?

The Pasco East main line (between Pasco and Spokane) passes through Connell in Franklin County, Ritzville in Adams County, and Sprague in Lincoln County. For the most part, the line runs parallel to US 395 and Interstate 90 (see **Exhibit A.8 on the previous page**). There is a short section of double track near Spokane and another between Cunningham and Sand. Centralized Traffic Control is used on the entire line. The maximum speed for passenger trains is 79 mph. The maximum speed for freight trains is 60 mph. Curves restrict passenger and freight train speed at numerous locations.

Moderate grades in two areas affect the capacity of the line. **Exhibits A.9 and A.10 on the following page** show the general locations of this main line's characteristics.

What are the characteristics of the Stampede Pass Route?

The former Northern Pacific main line through Stampede Pass is BNSF's central main line route. **Exhibit A.11 on Page A-13** presents the location of this route. The Stampede Pass route extends between Auburn and Pasco via Stampede Pass. From Pasco, the route travels north to Spokane via the Pasco East main line. The distance between Seattle and Spokane via this route is approximately 400 miles.

This line laid dormant for 14 years, but was rebuilt and reopened in December 1996. General freight traffic is transported over this route; however, the Stampede Tunnel does not currently have sufficient clearance to accommodate double-stack containers, tri-level auto cars, and certain trailer-on-flatcar loads.

Stampede Pass Main Line

The Stampede Pass main line is all single track between Auburn and Pasco. There is a very short section of second main track at Easton, in Kittitas County. The entire line is controlled by Track Warrant Control (TWC), with short sections of Centralized Traffic Control (CTC) and Restricted Limits. The sections of CTC are only located between the switches of sidings. The single tracks between these sidings operate by Track Warrant Control (TWC). There are no Automatic Block Signals (ABS) on this route. The Stampede Pass route is used only by BNSF freight trains.

Exhibit A.9
Pasco East Route: Grades

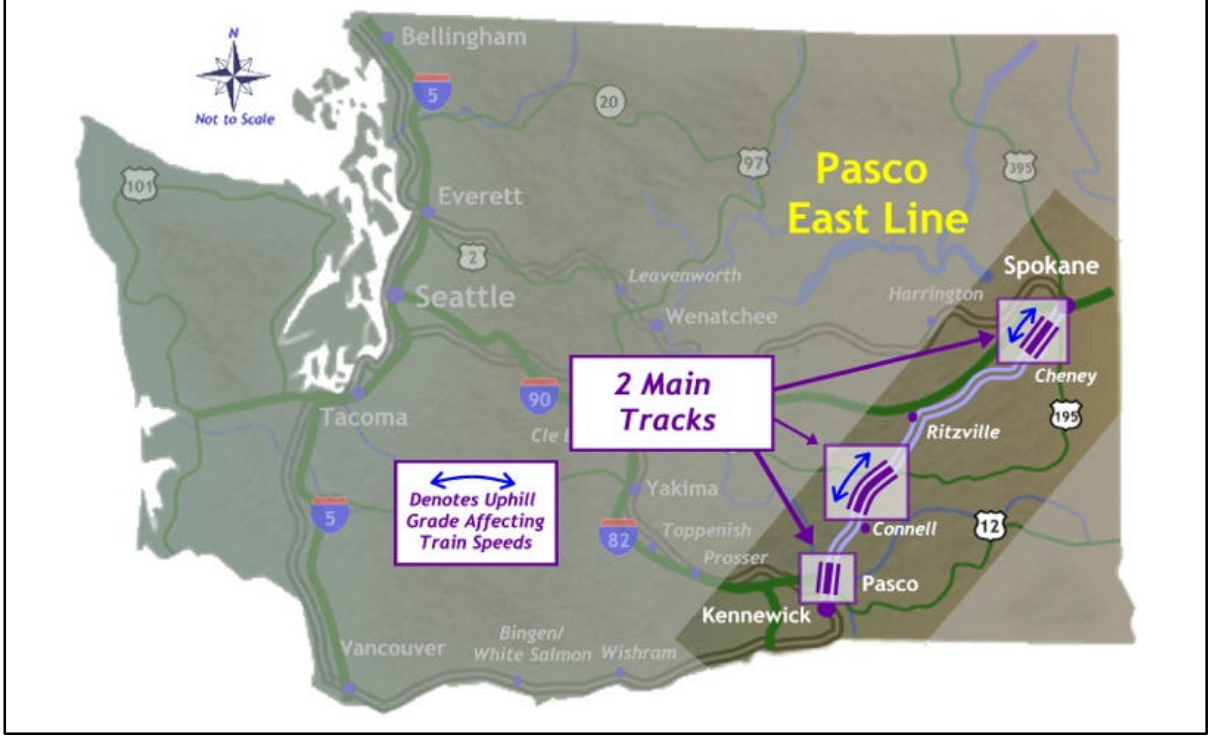


Exhibit A.10
Pasco East Route: Curves

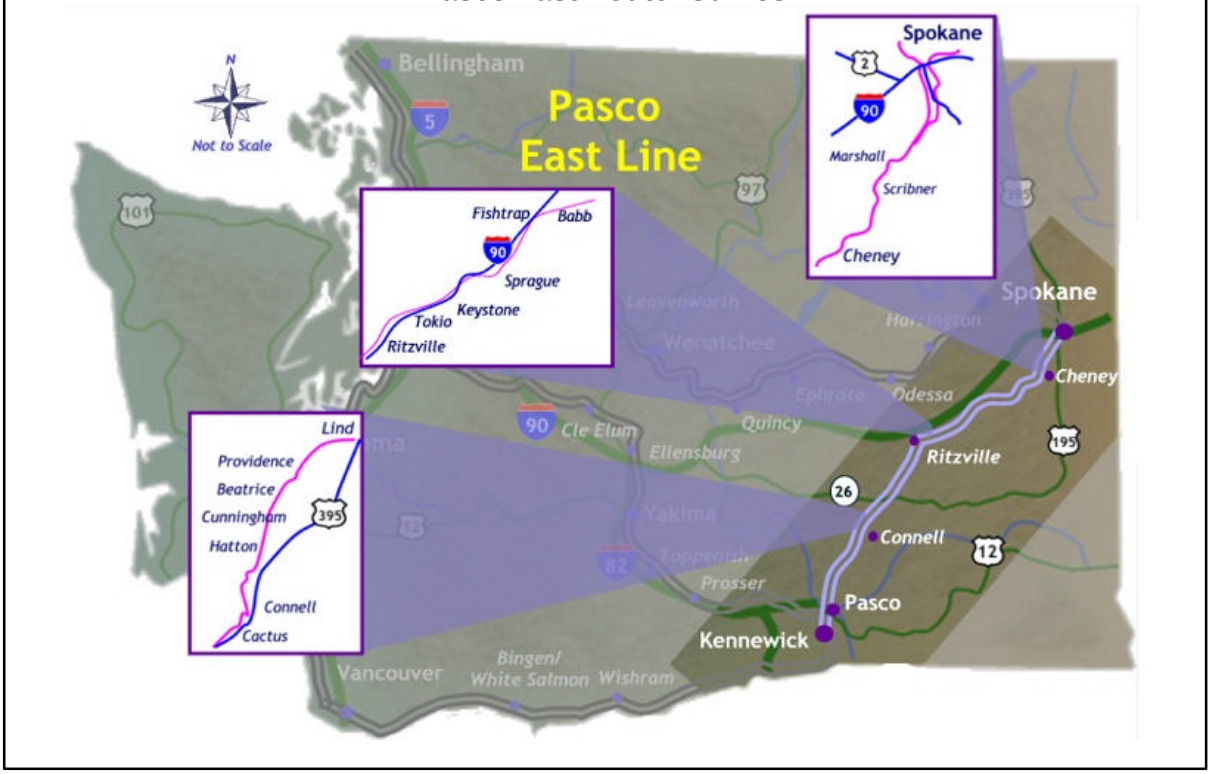


Exhibit A.11
Stampede Pass Route

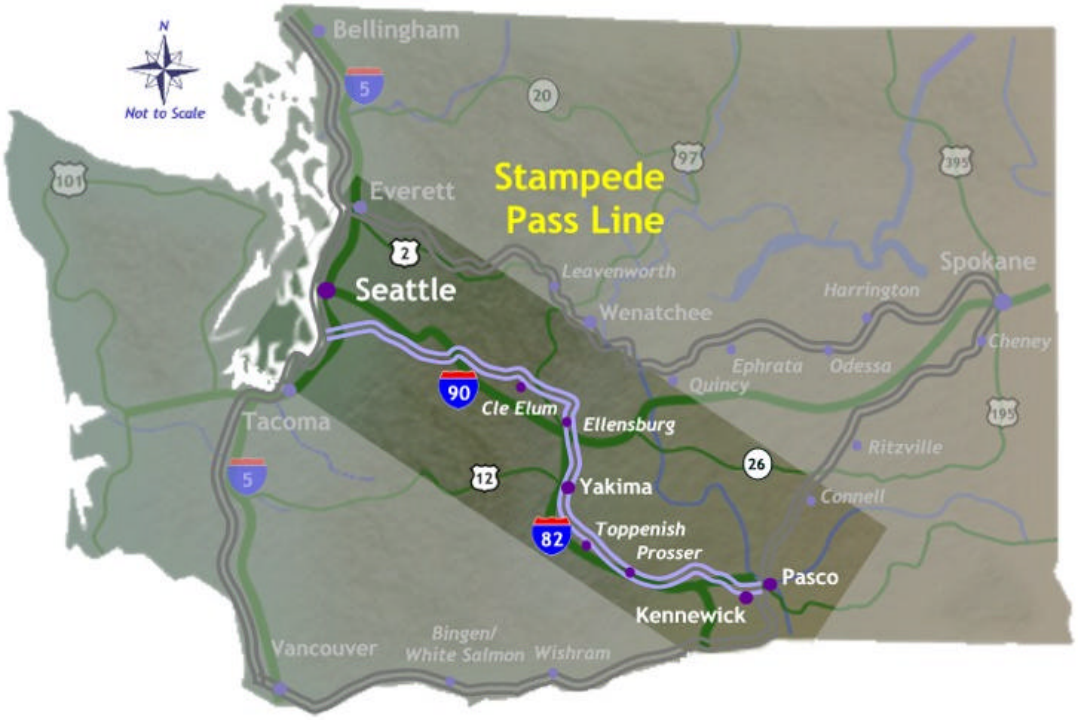
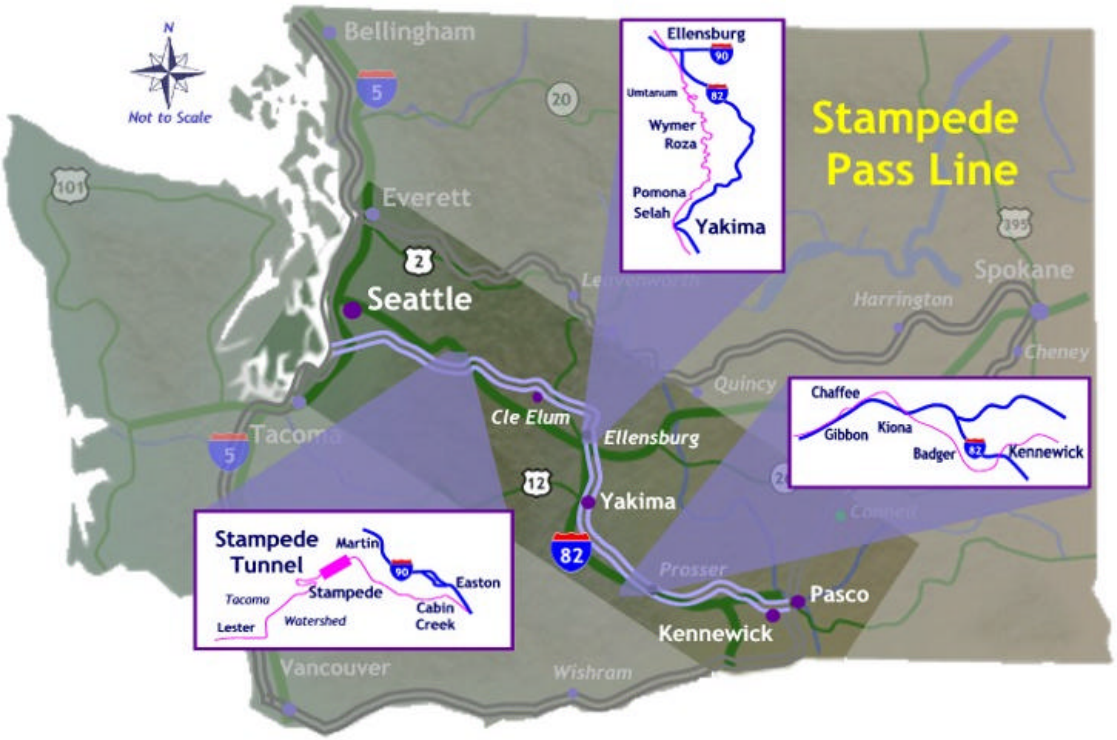


Exhibit A.12
Stampede Pass Route: Detail Map



There are several short segments of 0.8 to 1.1 percent grade. The ruling grade on this route is 2.2 percent, near the upper limit for typical main line freight operations nationally. The absence of a signal system limits freight trains to 49 mph and passenger trains to 59 mph. There are numerous curves on this line that also restrict the speed of trains. **Exhibit A.12 on the previous page** shows details of this route.

The Auburn – Pasco route is used by only a small number of trains. Some of the trains, such as empty grain trains, are not necessarily scheduled to operate normally on this line but are run on an as-needed basis.

Pasco East Main Line

The Pasco East main line is the same line used by freight and passenger trains traveling from the Columbia River Gorge line en route to Spokane.

Which of these routes can accommodate new passenger trains?

For the purposes of this preliminary analysis, a rough approximation of the capacity of the lines, their ability to operate additional trains, and their ability to operate reliably, was made. The following discusses the major constraints of each of the routes.

Stevens Pass Route

This preliminary review indicates that the Stevens Pass route has capacity constraints that are not easily solved. The Cascade Tunnel is popularly known as a major capacity constraint because of the need to ventilate the tunnel between trains. Heat and locomotive exhaust gas accumulates in the tunnel. This is not a significant problem in most railroad tunnels. The movement of the train pulls the exhaust gas while also drawing fresh air into the tunnel. The great length of the Cascade Tunnel makes ventilation with high horsepower fans necessary because the normal movement of air is insufficient to clear the exhaust gas from the tunnel. **Exhibit A.13 at the end of this section** provides an explanation about tunnel ventilation and its relationship to the sidings along the route.

However, the limiting capacity constraint actually is the running time between sidings. Because sidings are often used by slower trains to get out of the way of faster trains, the distance between sidings on this line contributes to the speed and time of day that a passenger train can travel along the route. The limitation imposed by the running time between sidings at Skykomish and Scenic and between Scenic and Berne is approximately 75 minutes in each direction.

Preliminary calculations indicate that running time between sidings is 75 minutes. Allowing six hours per day for track maintenance,[A.7] the capacity of the line is about 28 trains per day. Theoretically, the main line could then support an average count of 22 trains per day. However, these calculations also assume that traffic is evenly distributed throughout the day, which, as stated earlier, would be unusual for a typical rail line and is probably not the case. Because

[A.7] Track maintenance crew shifts are eight hours per day. It is assumed that approximately six of these hours are productive, working hours for the crew.

of that, some periods of congestion and delays can be expected.

Reducing the running time between Skykomish, Scenic, and Berne is actually more important than reducing the ventilation time in the Cascade Tunnel. This is not a simple undertaking. Running time reduction may be accomplished by raising train speed or reducing the distance between sidings. The former is not practical because of sharp curves and steep grades. The latter may be practical between Skykomish and Scenic but is not practical to an effective degree between Scenic and Berne through the tunnel.

Columbia River Gorge Route

The capacity limitation on the Columbia River Gorge route is imposed by siding-to-siding running time of 20 minutes in at least two places west of Wishram. East of Wishram, the sidings are about ten minutes apart, but five of the sidings (located between two longer sidings), are much shorter than most sidings along the line. These short sidings either limit train length (thus, limiting capacity), or double the running time between sidings that can be used (also limiting capacity).

Preliminary calculations indicate that running time between sidings is 20 minutes. Allowing six hours per day for track maintenance, the capacity of the line is about 40 trains per day. Theoretically, the main line could then support an average count of 30 trains per day. However, these calculations also assume that traffic is evenly distributed throughout the day, which, as stated earlier, would be unusual for a typical rail line and is probably not the case. Because of that, some periods of congestion and delays can be expected.

Stampede Pass Route

Preliminary review of the Stampede Pass route indicates that the current traffic on the route is extremely light. In addition, this preliminary review indicates that there are no major physical constraints that would limit expansion of the existing infrastructure.

Based on the physical and operational conditions of the Stampede Pass route, it was concluded that a preliminary assessment of this route could result in significant and meaningful findings.

Which route shows the most promise for potential passenger rail service?

A comparison of the three east-west routes indicates that the Stampede Pass route may have the capability of handling additional traffic.

However, an in-depth study of the other two routes in the years ahead may indicate that additional daylight passenger service is feasible.

Exhibit A.13

THE CASCADE TUNNEL AND CAPACITY LIMITATION - 1

TUNNEL VENTILATION

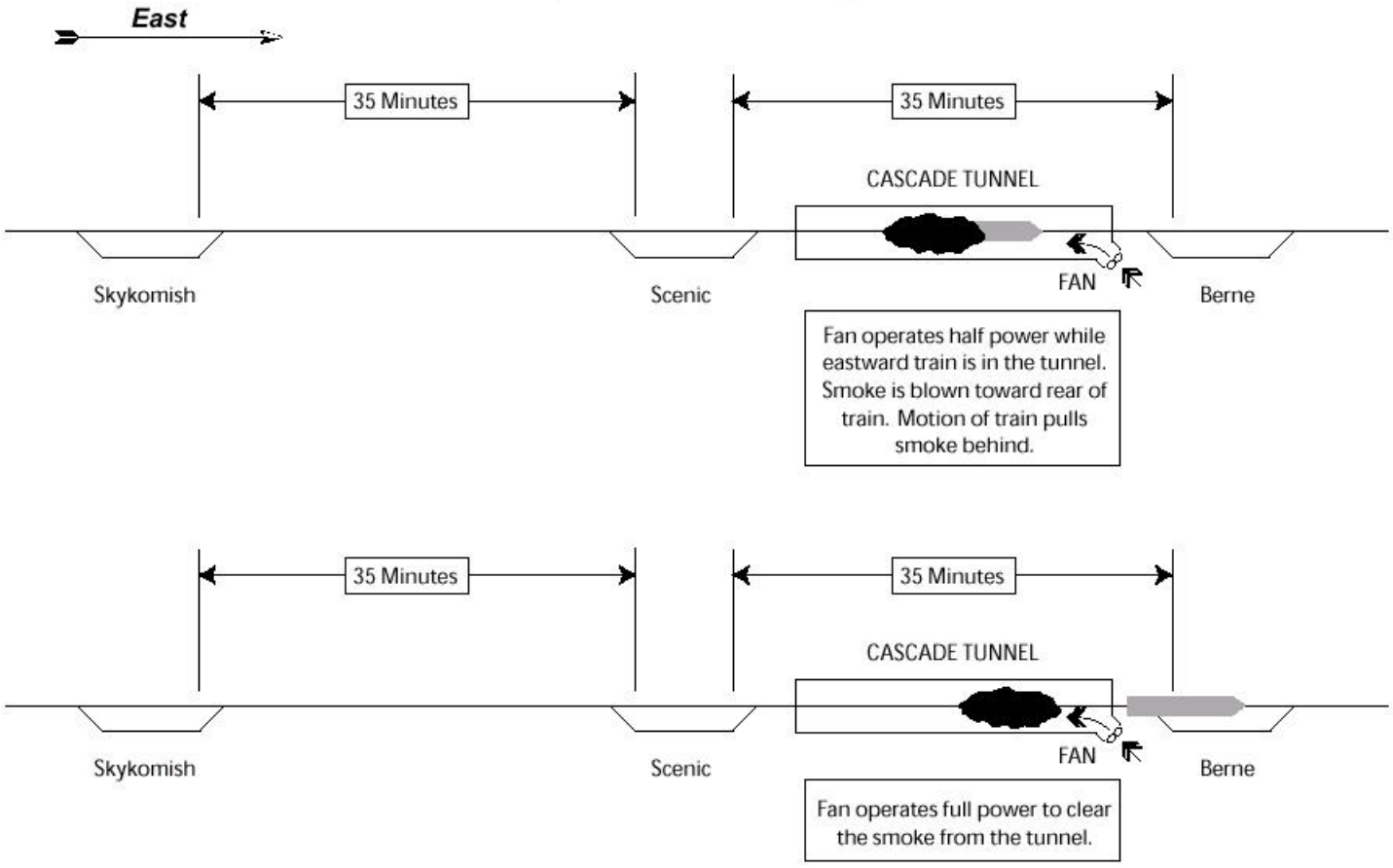


Exhibit A.13—Continued

THE CASCADE TUNNEL AND CAPACITY LIMITATION - 2

HOW TUNNEL VENTILATION AFFECTS CAPACITY

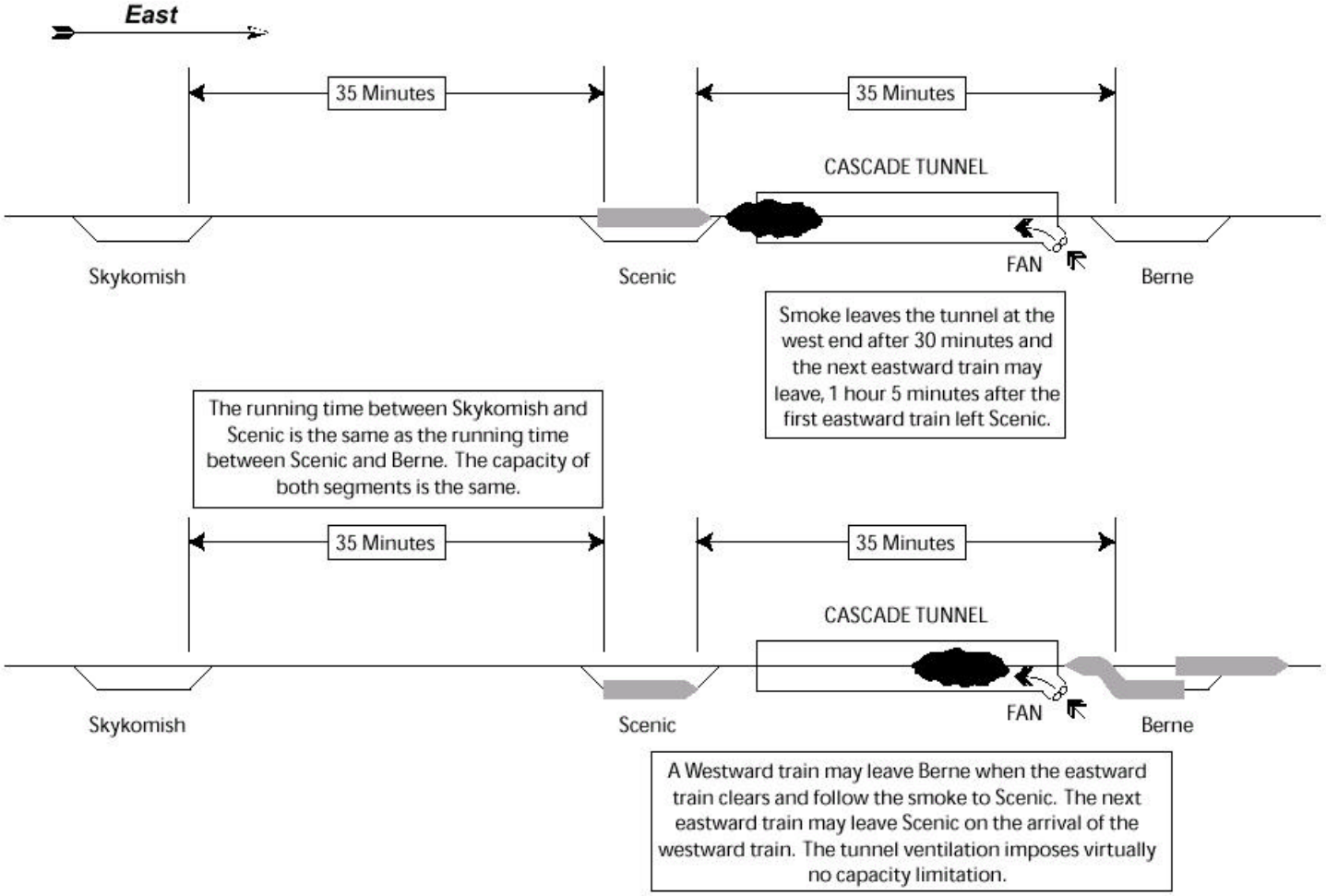


Exhibit A.13—Continued

THE CASCADE TUNNEL AND CAPACITY LIMITATION - 3

INCREASING CAPACITY